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Orthosia hibisci (Guenée), the speckled green fruitworm: confirmed causing extensive hardwood defoliation in Southcentral and Western Alaska

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Introduction

In 2016, the speckled green fruitworm, *Orthosia hibisci*(Guenï£¡e) (Figure 3), was confirmed to be contributing to extensive hardwood defoliation in parts of the Alaska and northern Aleutian Ranges and is suspected as the cause of comparable defoliation in areas of Western Alaska (FS-R10-FHP, 2017). *Orthosia hibisci* was also suspected as having caused widespread defoliation in the aforementioned areas in 2014 and 2015 (Figure 2). This defoliation event was initially documented via aerial surveys, during which the cause of the damage was suspected of being the related species, *Sunira verberata*(Smith), battered sallow moth (FS-R10-FHP, 2016). That moth was thought to be the primary pest in the same area from 2000-2006 (FS-R10-FHP, 2007), but defoliation over those years may have been exacerbated by other species such as *O. hibisci*.

The Defoliation

In 2014, approximately 9,500 acres of willow, alder, and birch defoliation were observed during the forest health aerial detection surveys along the Upper East and West Forks of the Yentna River, as well as on the eastern side of Mystic Pass (Figure 1). At the time, the damage agent was unknown.

During the 2015 field season, more than 180,000 acres of hardwood defoliation similar to that observed in 2014 were documented in the Alaska and northern Aleutian Ranges and Western Alaska. Also in 2015, numerous reports of damage were received from across the impacted areas. National Park Service (NPS) staff and volunteers forwarded damage reports from Lake Clark National Park and Preserve(LCNP) to Forest Health Protection (FHP) staff and also reported extensive defoliation on the east end of Telaquana Lake. Defoliation was reported in the Shell Hills area of the Susitna River valley and up the Skwentna River by a private citizen. Additional damage was also reported and mapped in the following locations: Lake Chakachamna, upper East and West Forks of the Yentna River, Yenlo Hills, Chakachatna and McArthur Rivers area, Nerka Lake in Wood-Tikchik State Park, and along the Innoko and Yukon Rivers near Holy Cross.

Figure 1: Defoliation caused by *Orthosia hibisci* along the upper Yentna in summer of 2016 J. Moan, AKDOF.

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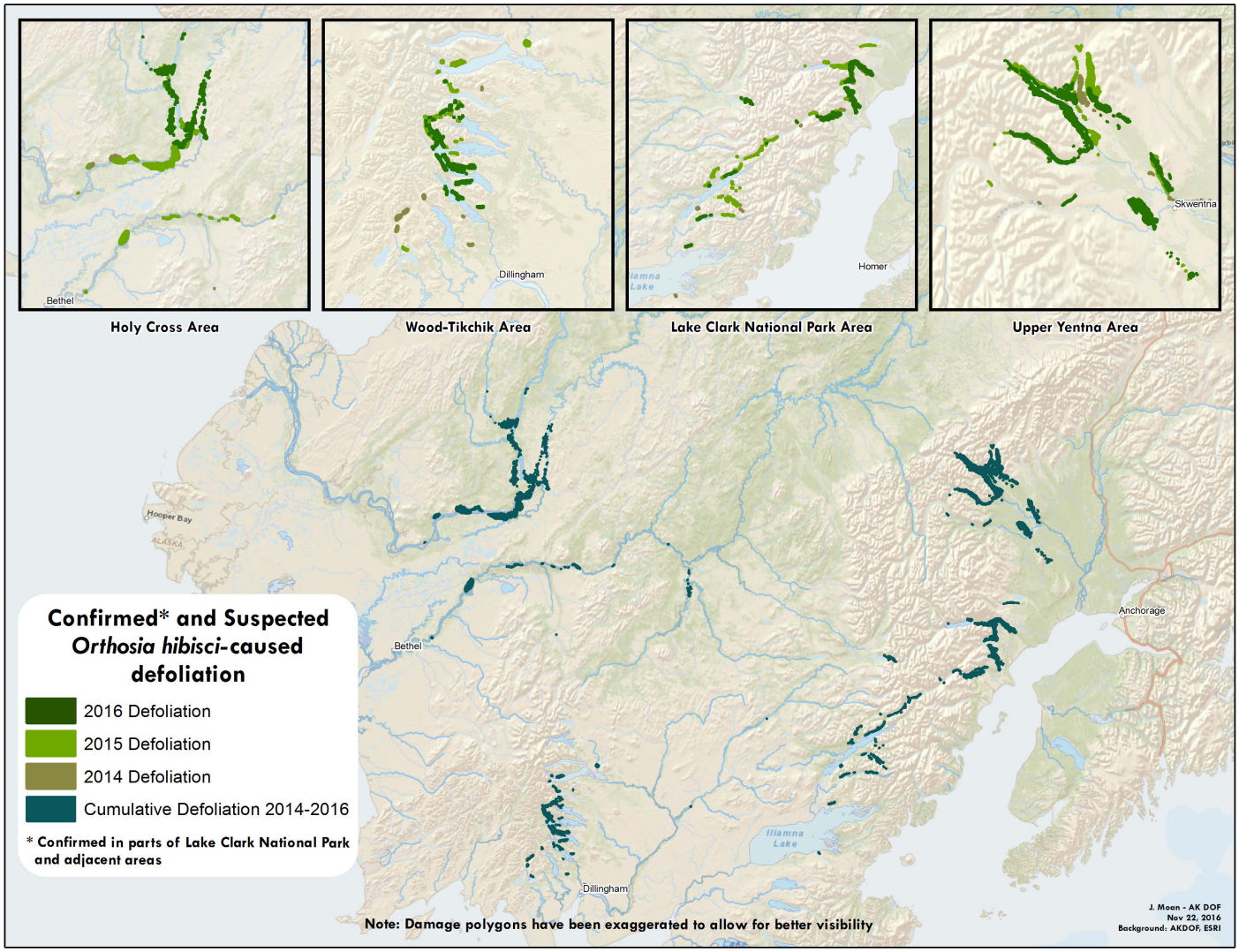

Figure 2: Map showing confirmed and suspected *Orthosia hibisci*-caused defoliation 2014-2016. J. Moan, AKDOF.

Based on the observed symptoms of defoliation, the history of defoliation in parts of the region, and comparison of larval reference images with observed specimens, the defoliation documented in 2014 and 2015 was suspected to have been caused by *Sunira verberata*. Outbreaks of *S. verberata* have been documented during aerial surveys in the past, specifically from 2003 to 2008 in Wood-Tikchik State Park and Katmai National Park. To the best of our knowledge, during previous aerial detection surveys, neither *S. verberata* nor *O. hibisci* had been documented as causing such widespread defoliation as observed during the last few years.

In early summer 2016, damage on the east end of Telaquana Lake was again reported from LCNP staff and volunteers. A private citizen also provided images of larvae and physical moth specimens that were collected along the northeast shore of Lake Clark. Additionally, Bureau of Land Management staff and U.S. Fish and Wildlife Service staff out of the Koyukuk/Nowitna/Innoko National Wildlife Refuges reported heavy defoliation and provided images of larvae and defoliated willows around Holy Cross and along the Innoko River from Shageluk to the Yukon River, up the Yukon River to Anvik, and along the Anvik River. In 2016, defoliation mapped in these areas, as well as the expansion of those defoliated areas mapped in 2015, totaled roughly 160,000 acres.

The Defoliator

A ground survey was conducted by FHP and Alaska Division of Forestry (DOF) staff on June 8, 2016 at

Chakachamna and Telaquana Lakes to collect specimens for rearing and identification (Figure 4). Accurate identification to species using morphological characteristics typically requires adult specimens.

Figure 3: *Orthosia hibisci* moth in spring of 2015. J. Mills and J. Mills, NPS.

Larvae were observed feeding gregariously at both locations. Defoliation and scattered dieback in willow and alder was evident. Defoliation was also observed in cottonwood and birch, though impacts were minor in comparison. Larvae and feeding damage extended onto many non-woody plants in the area, including grasses and other herbaceous groundcover.

Two color variations were observed in the larvae, a green variation and a dark green to almost black variation. Chapman and Lienk (1974) noted that the dark variation can occur when larvae are crowded, such as during high populations (Figure 5). This also occurs in other species such as *Operophtera bruceata*(Hulst) (James Kruse, US Forest Service, personal communication).

Figure 4: *Orthosia hibisci* feeding on willow foliage at Telaquana Lake, June 2016. S. Swenson, USFS FHP.

Figure 5: Dark and light color variations of *Orthosia hibisci* larvae. G. Dubois, USFS FHP.

Larvae were collected at both locations and were then transferred to rearing chambers at both the FHP and DOF labs (Figure 6). The intention was to rear moths for identification. Conditions in the labs were not consistent with natural conditions, staying consistently warmer (60°–70°F) with lighting often brighter and more variable than outdoor conditions. Larvae were fed new host material as needed and by late June, the majority of larvae had pupated (Figure 7). The proportion of larvae that survived to the pupal stage cannot be confirmed across all rearing chambers, but in some cases, survival to prepupa was at or above 50%. Larvae, when possible, buried themselves in the substrate to pupate (Figure 8). By October 2016, the specimens remained as pupae and there was suspicion

that either the rearing conditions had not been ideal or that these specimens were not the suspected *S. verberata*, for which adults are known to emerge in the fall.

Figure 6: Rearing chambers used in the USFS FHP lab. G. Dubois, USFS FHP.

FHP also staff submitted larvae that were collected at lake Telaquana and moths collected in the spring from Lake Clark for DNA identification.

> Samples were identified using LifeScanner (`http://lifescanner.net/`). Lifescanner is a DNA-barcoding service for citizen scientists that consists of a standardized sampling kit, mobile app, and standardized laboratory workflow. It is a project run out of the Centre for Biodiversity Genomics (`http://biodiversitygenomics.net/`) at the University of Guelph that DNA barcodes user-provided samples. Taxonomic identifications are generated through the Barcode of Life Data (BOLD) Systems ID Engine(Sujeevan Ratnasingham, Lifescanner principal Investigator, personal communication, see Ratnasingham and Hebert, 2007).

This DNA analysis identified both the adult moths and larval specimens as *O. hibisci*, a native generalist defoliator in the family Noctuidae. *Orthosia hibisci* has a very wide host preference, but is typically described as a fruit orchard pest feeding on foliage and immature fruits of numerous fruit trees in the family Rosaceae. Upwards of 40 hardwood and coniferous trees and shrubs are also known to be hosts, including alder, white birch, cottonwood, quaking aspen, and willow (Chapman and Lienk, 1974; Rings, 1970).

Figure 7: Various life stages of Orthosia hibisci. G. Dubois, USFS FHP.

Figure 8: Prepupae and pupae buried and partially buried in substrate. Where the substrate was deep enough or enough debris was present, many prepupae would bury themselves completely. G. Dubois, USFS FHP.

In addition to the June collections, in late April and early May of 2016 reports of a mass emergence of unknown moths were received from several locations in Western Alaska, including Bethel and Holy Cross. Numerous reports and photographs were received from these areas. Based on the photos, the moths were initially suspected of being *S. verberata*, however the phenology was not consistent. Acquisition of specimens from this event was facilitated through the Anchorage and Bethel University of Alaska Fairbanks - Cooperative Extension offices. Specimens were obtained by a local Bethel resident and sent to

taxonomists Dr. James J. Kruse and Dr. Clifford D. Ferris for identification and were also confirmed as *O. hibisci.*

Conclusions

Work done throughout the 2016 field season resulted in *O. hibisci* being confirmed as the causal agent of defoliation at several sites. Although *O. hibisci* is currently the only species to be confirmed in the impacted areas, other defoliators may be present and contributing to defoliation in the region. Future efforts will be made to collect and confirm specimens from other similarly impacted areas to determine distribution, defoliator species present, and host plants affected.

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